Climate Change & Air Quality

Climate Change and GHG Emissions Trends

Climate change and air pollution are closely coupled. Just as air pollution can have adverse effects on human health and ecosystems, it can also impact the Earth's climate. When energy from the sun reaches the Earth, the planet absorbs some of this energy and radiates the rest back to space as heat. The Earth's surface temperature depends on this balance between incoming and outgoing energy. Atmospheric greenhouse gases (GHGs) like carbon dioxide (CO_2) and methane (CH_4) can trap this energy and prevent the heat from escaping.

In 2009, EPA issued a finding under the Clean Air Act that GHGs constitute air pollution that threatens public health and welfare. The science supporting that finding allowed EPA to conclude that warming of the climate system is unequivocal, and that most of the observed increase in global average temperatures since the mid-20th century is very likely due to the anthropogenic increase in GHG concentrations (EPA, 2009). EPA has further concluded that there is compelling evidence that many fundamental measures of climate in the United States are changing, and many of these changes are linked to the accumulation of GHGs in the atmosphere. Examples of these climate-driven effects include warmer air and ocean temperatures, more high-intensity rainfall events, and more frequent heat waves.

In collaboration with other government agencies, EPA tracks both GHG emissions (EPA, 2011) and indicators of climate change (EPA, 2010). Figure 25 shows trends in domestic GHG emissions over the past two decades. Total U.S. GHG emissions have increased 7.3 percent from 1990 to 2009. The majority of domestic GHG emissions result from electricity generation and transportation.

In January 2012, EPA released for the first time comprehensive greenhouse gas (GHG) emissions data reported directly from large facilities and suppliers across the country through the GHG Reporting Program. The 2010 GHG data includes public information from facilities in nine industry groups that directly emit large quantities of GHGs (e.g., power plants, petroleum refineries, landfills, etc.) as well as suppliers of certain fossil fuels. EPA's online data publication tool allows users to view and sort GHG

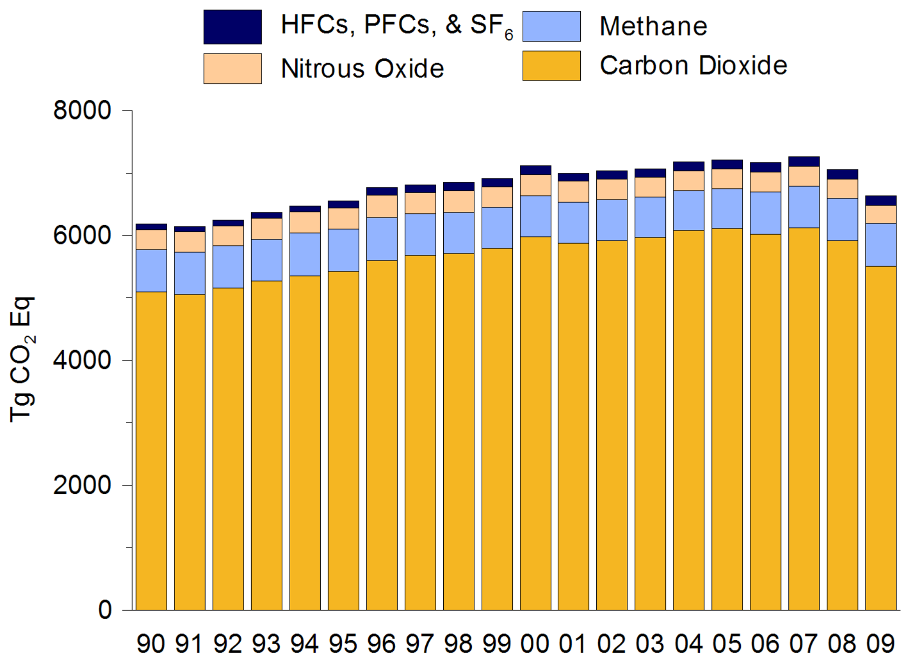

Figure 25. Domestic greenhouse gas emissions in teragrams of carbon dioxide equivalents (Tg CO_2 eq), 1990-2009. (EPA, 2011)

Notes: A teragram is equal to 1 million metric tons. Emissions in the figure include fluorocarbons (HFCs, PFCs) and sulfur hexafluoride (SF_6). CO2 eq refers to the global warming potential (GWP) of each greenhouse gas (e.g., nitrous oxide) as compared to the GWP of CO2 (EPA, 2011) data from more than 6,700 facilities in a variety of ways; including by facility, location, industrial sector, and type of GHG emitted. This information can be used by communities to identify nearby sources of greenhouse gas emissions, help businesses track emissions and find cost- and fuel-saving opportunities, and provide information to the finance and investment communities. For more information, visit http://epa.gov/climatechange/emissions/ghgdata.

Climate Impacts of Air Pollution

Conventional air pollutants such as ozone and particle pollution can also contribute to climate change. Because ozone and particle pollution stay in the atmosphere for only a few days or weeks, reducing these emissions can help reduce climate impacts in the near-term.

Ozone is a significant contributor to climate warming, as shown in Figure 25. The climate impacts of ozone are greatest when the ozone is located in the upper part of the troposphere. Concentrations of ozone in this part of the Earth's atmosphere, sometimes referred to as "global background ozone," are determined by worldwide emissions of CH_4, CO, NOx , and VOCs; as well as by natural processes like lightning and transport from the stratosphere. While ground-level ozone concentrations over the U.S. are generally declining, there is evidence that global background ozone levels continue to rise (Cooper, 2010).

Particle pollution can also have significant impacts on climate, both directly and indirectly. The direct effects come from particles' ability to absorb and scatter light. Different types of particles have different impacts on climate: some warm (e.g., black carbon); others cool (e.g., sulfates and nitrates). Black carbon, a component of soot particles, contributes to global warming by absorbing sunlight, thereby heating the atmosphere. When black carbon is deposited on snow and ice, melting accelerates. Black carbon's effects are particularly strong in the Arctic and other alpine regions. The direct effects of particles on climate are shown in Figure 25. Particle pollution can also have important indirect effects on climate. For example, particles can change the reflectivity of clouds and also indirectly influence cloud lifetime and precipitation.

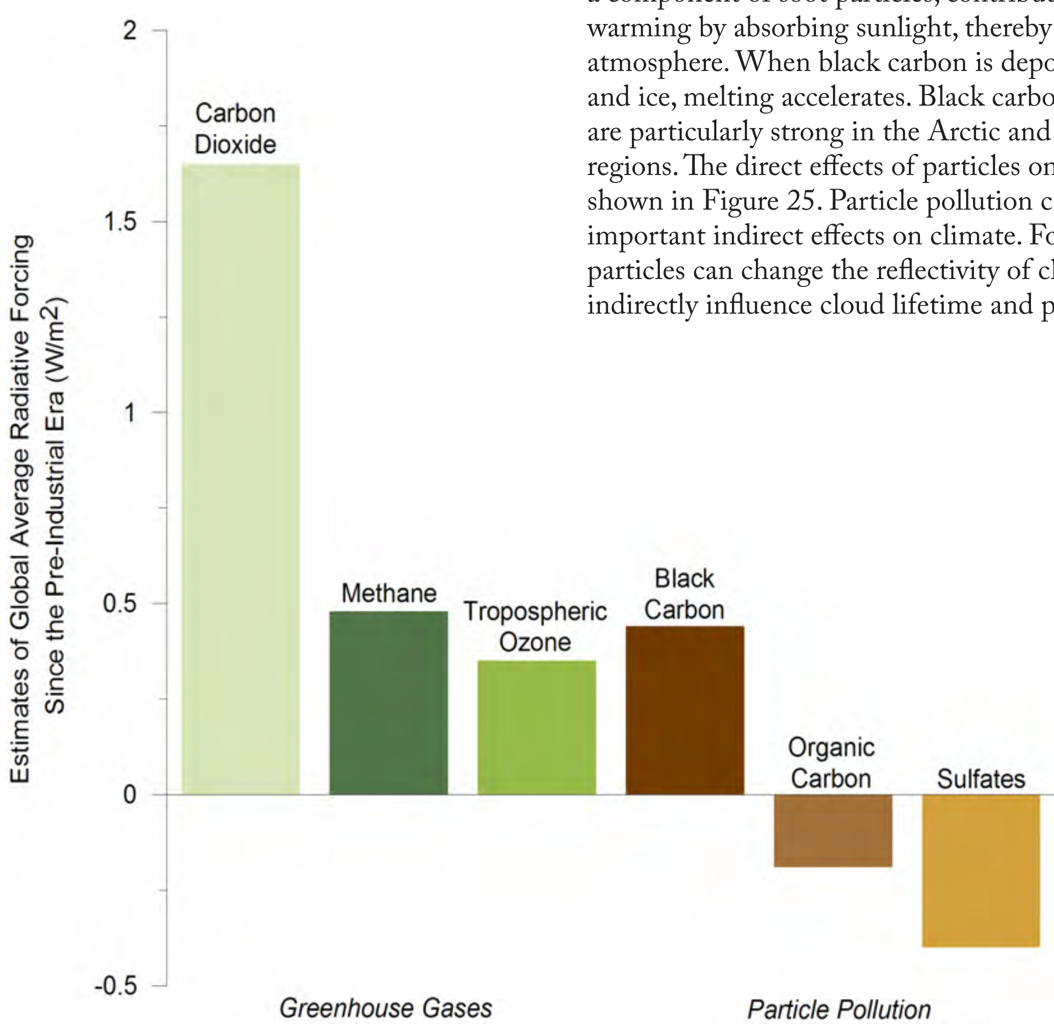

Figure 26. Estimates of global average radiative forcing (W/m2) resulting from changes in key climate-related air pollutants between the pre-industrial era and 2005. Data source: Forster, et. al., 2007. For additional information on the level of scientific understanding for key climate-related air pollutants see Forster, et.al., 2007.

The net effect for all particles in the atmosphere is cooling, as scattering generally dominates, though effects can vary dramatically by region (Forster et. al., 2007). While the health benefits of reducing all types of emissions contributing to particle pollution are relatively clear, the net climate impact of emissions reduction strategies will depend on the relative reductions in particles of different types.

Air Quality Impacts of Climate Change

The close connection between climate and air quality is also reflected in the impacts of climate change on air pollution levels. As previously discussed, ozone and particle pollution are strongly influenced by shifts in the weather (e.g., heat waves or droughts). Based on projected future climate scenarios, and in the absence of additional emissions reductions, the Intergovernmental Panel on Climate Change (IPCC) projected "declining air quality in cities" into the future as a result of climate change. Further, EPA concluded in 2009 that GHG emissions "may reasonably be anticipated both to endanger public health and to endanger public welfare." This endangerment finding was based, in part, on the potential for climate change to worsen air quality over the U.S. and the accompanying public health impacts that would result.

EPA has concluded (EPA, 2009) that climate change could have the following impacts on national air quality levels:

- Produce 2-8 ppb increases in summertime average ground-level ozone concentrations in many regions of the country.
- Further exacerbate ozone concentrations on days when weather is already conducive to high ozone concentrations
- Lengthen the ozone season
- Produce both increases and decreases in particle pollution over different regions of the U.S.

Because climate represents meteorological conditions over a long period of time, it is difficult to identify a climate fingerprint in the current trends in air quality discussed earlier in this report. Given the general improvement in air quality over the past decade, it appears that emissions reductions from air quality regulations are outpacing any climate-driven impacts.